

What is claimed is:

1. A polycrystalline translucent aluminum oxide ceramic material having an average grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7.

2. The polycrystalline translucent ceramic material of claim 1 wherein no greater than 10% of the grains of a polished surface of the material has a largest dimension greater than 1.0 micron.

3. The polycrystalline translucent ceramic material of claim 1 having a wet transmittance of at least about 40% at about 550 nm.

4. The polycrystalline translucent ceramic material of claim 3 having a wet transmittance of at least about 50% at about 650 nm.

5. The polycrystalline translucent ceramic material of claim 1 wherein a wet transmittance curve over a range of about 475 nm to about 650 nm has an integrated area of greater than about 70%T-nm.

6. The polycrystalline translucent ceramic material of claim 1 wherein the material has a Contrast Ratio value of less than about 0.5.

7. The polycrystalline translucent ceramic material of claim 6 wherein the material has a Contrast Ratio value of less than about 0.4.

8. The polycrystalline translucent ceramic material of claim 1 having a flexure strength of at least about 400 MPa.

9. The polycrystalline translucent ceramic material of claim 8 having a flexure strength of at least about 600 MPa.

10. The polycrystalline translucent ceramic material of claim 1 having a purity of at least about 99.5 wt-%.

11. The polycrystalline translucent ceramic material of claim 10 comprising up to about 0.5 wt-% of magnesium oxide, yttrium oxide, zirconium oxide, hafnium oxide, calcium oxide, or combinations thereof.

12. The polycrystalline translucent ceramic material of claim 1 wherein the material is in the form of a dental article, an infrared radar dome, a sodium vapor lamp envelope, a window, or military armor.

13. The polycrystalline translucent ceramic material of claim 12 wherein the material is in the form of a dental article.

14. The polycrystalline translucent ceramic material of claim 13 wherein the dental article is a dental prosthesis.

15. The polycrystalline translucent ceramic material of claim 14 wherein the dental prosthesis is selected from the group consisting of a crown, a coping, a bridge framework, a dental implant, a dental implant abutment, an inlay, an onlay, and a veneer.

16. A dental mill blank comprising a polycrystalline translucent aluminum oxide ceramic material having an average grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7.

17. The dental mill blank of claim 16 wherein the blank is mounted to a holder selected from the group of a stub, a frame, a collet, and a plate.

18. The dental mill blank of claim 16 wherein the ceramic material has a tooth-like shade.

19. The dental mill blank of claim 16 wherein no greater than 10% of the grains of a polished surface of the ceramic material has a largest dimension greater than 1.0 micron.

20. The dental mill blank of claim 16 wherein the ceramic material has a wet transmittance of at least about 40% at about 550 nm.

21. The dental mill blank of claim 20 wherein the ceramic material has a wet transmittance of at least about 50% at about 650 nm.

22. The dental mill blank of claim 16 wherein a wet transmittance curve of the ceramic material over a range of about 475 nm to about 650 nm has an integrated area of greater than about 70%T-nm.

23. The dental mill blank of claim 16 wherein the ceramic material has a Contrast Ratio value of less than about 0.5.

24. The dental mill blank of claim 23 wherein the ceramic material has a Contrast Ratio value of less than about 0.4.

25. The dental mill blank of claim 16 wherein the ceramic material has a flexure strength of at least about 400 MPa.

26. The dental mill blank of claim 25 wherein the ceramic material has a flexure strength of at least about 600 MPa.

27. The dental mill blank of claim 16 wherein the ceramic material has a purity of at least about 99.5 wt-%.

28. The dental mill blank of claim 16 wherein the ceramic material comprises up to about 0.5 wt-% of magnesium oxide, yttrium oxide, zirconium oxide, hafnium oxide, calcium oxide, or combinations thereof.

29. A ceramic dental prosthesis comprising a polycrystalline translucent aluminum oxide ceramic material having an average grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7.
- 5 30. The prosthesis of claim 29 wherein the ceramic material is coated at least partially with an aesthetic coating material selected from the group consisting of porcelain, glass, glass-ceramic, composite, resin ceramic composite, and combinations thereof.
- 10 31. The prosthesis of claim 29 wherein the prosthesis is attached to tooth structure with dental cement.
- 15 32. The prosthesis of claim 29 wherein no greater than 10% of the grains of a polished surface of the ceramic material has a largest dimension greater than 1.0 micron.
33. The prosthesis of claim 29 wherein the ceramic material has a wet transmittance of at least about 40% at about 550 nm.
- 20 34. The prosthesis of claim 29 wherein the ceramic material has a wet transmittance of at least about 50% at about 650 nm.
- 25 35. The prosthesis of claim 29 wherein a wet transmittance curve of the ceramic material over a range of about 475 nm to about 650 nm has an integrated area of greater than about 70%T-nm.
36. The prosthesis of claim 29 wherein the ceramic material has a Contrast Ratio value of less than about 0.5.
- 30 37. The prosthesis of claim 36 wherein the ceramic material has a Contrast Ratio value of less than about 0.4.

38. The prosthesis of claim 29 wherein the ceramic material has a flexure strength of at least about 400 MPa.

39. The prosthesis of claim 38 wherein the ceramic material has a flexure strength of at least about 600 MPa.

40. The prosthesis of claim 29 wherein the ceramic material has a purity of at least about 99.5 wt-%.

41. The prosthesis of claim 29 wherein the ceramic material comprises up to about 0.5 wt-% of magnesium oxide, yttrium oxide, zirconium oxide, hafnium oxide, calcium oxide, or combinations thereof.

42. A kit comprising:  
a dental mill blank comprising a polycrystalline translucent aluminum oxide ceramic material having an average grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7; and  
instructions for using the mill blank.

43. The kit of claim 42 further comprising a component selected from the group consisting of a bonding agent, a milling lubricant, a color-matching composition suitable for use in the oral environment, an impression material, an instrument, a dental composite, a dental porcelain, an abrasive, and combinations thereof.

44. A method for making a polycrystalline translucent aluminum oxide ceramic material having a grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7, the method comprising:

providing an aluminum oxide powder;

forming the powder into an article having a desired shape;

sintering the shaped article to obtain a sintered article having closed porosity; and

subjecting the sintered article to hot isostatic pressing to further densify and form a densified article comprising polycrystalline translucent aluminum oxide ceramic material having a grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7.

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45. The method of claim 44 further comprising deagglomerating the aluminum oxide powder prior to forming the powder into an article having a desired shape.

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46. The method of claim 45 wherein deagglomerating the aluminum oxide powder comprises subjecting the aluminum oxide powder to ultra-sonication.

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47. The method of claim 44 wherein subjecting the sintered article to hot isostatic pressing comprises subjecting the sintered article to hot isostatic pressing at a temperature of about 1200°C to about 1300°C for about 30 minutes to about 120 minutes under about 100 MPa to about 210 MPa of an inert gas.

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48. The method of claim 44 wherein forming the powder into an article having a desired shape comprises forming a mill blank comprising ceramic material in a green stage.

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49. The method of claim 48 further comprising carving the green-stage mill blank into a desired shape prior to sintering the shaped article to obtain a sintered article having closed porosity.

50. The method of claim 44 further comprising carving the sintered article having closed porosity into a desired shape prior to subjecting the sintered article to hot isostatic pressing to further densify.

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51. The method of claim 44 further comprising carving the densified article into a desired shape.

52. The method of claim 44 wherein forming the powder into an article having a desired shape comprises slurry casting the aluminum oxide powder.

53. The method of claim 44 wherein forming the powder into an article having a desired shape comprises injection molding the aluminum oxide powder.

54. The method of claim 44 wherein the aluminum oxide powder has a surface area of greater than about 10 m<sup>2</sup>/g.

55. The method of claim 54 wherein the aluminum oxide powder has a surface area of greater than about 14 m<sup>2</sup>/g.

56. The method of claim 44 wherein the aluminum oxide powder has a purity of at least about 99.5%.

57. The method of claim 44 wherein the densified article is a dental mill blank.

58. The method of claim 44 wherein the densified article is a dental prosthesis.

59. A method for making a dental prosthesis comprising:  
providing a dental mill blank comprising a polycrystalline translucent aluminum oxide ceramic material having a grain size of no greater than 1.0 micron and a Contrast Ratio value of less than about 0.7; and  
carving the mill blank into a desired shape.

60. The method of claim 59 further comprising attaching the carved blank to tooth or bone structure.

61. The method of claim 60 wherein the carved blank is attached to the tooth or bone structure with a color-matching bonding agent.